

(19)



Europäisches Patentamt

European Patent Office

Office européen des brevets

(11)

Publication number:

0 069 795**A1**

(12)

EUROPEAN PATENT APPLICATION

(21)

Application number: 81105513.6

(51)

Int. Cl.³: **G 07 F 13/00**
F 25 C 5/00

(22)

Date of filing: 14.07.81

(43)

Date of publication of application:
19.01.83 Bulletin 83/3

(84)

Designated Contracting States:
DE FR GB IT

(71)

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(54)

An automatic vending machine with ice preparation.

(57)

An automatic vending machine is disclosed having an ice machine (FR) with a storage chamber (CH) in which the ice produced is stored and from which the ice is supplied whenever a sale requires it. A counter (8) is provided and supplied with digital signals which represent quantities of ice produced for and discharged from the storage chamber. The counter produces an output signal (S_a) when its count is not less than a predetermined minimum value. As soon as this output signal of the counter (8) disappears sales are vetoed.

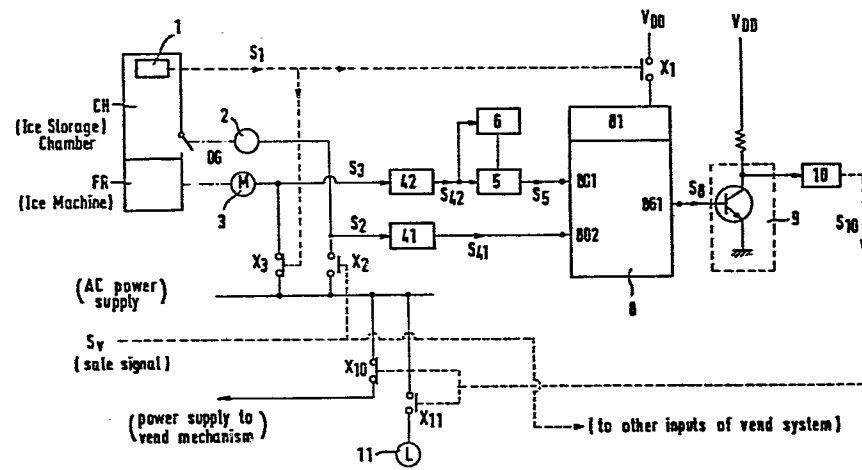


FIG. 1

BLUMBACH · WESER · BERGEN · KRAMER
ZWIRNER · HOFFMANN

PATENTANWÄLTE IN MÜNCHEN UND WIESBADEN

Patentconsult Radeckestraße 43 8000 München 60 Telefon (089) 883603/883604 Telex 05-212313 Telegramme Patentconsult
Patentconsult Sonnenberger Straße 43 6200 Wiesbaden Telefon (06121) 562943/561998 Telex 04-186237 Telegramme Patentconsult

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81/8717 EPC

AN AUTOMATIC VENDING MACHINE WITH ICE PREPARATION

- 1 The invention relates to an automatic vending machine to serve beverages with ice according to the precharacterizing clause of claim 1, and specifically to its vending service control device for ice storage therein.
- 5
- A typical iced beverage vendor has an ice machine with an ice storage chamber. Whenever a sale signal is received, an adequate quantity of ice is supplied from the storage chamber to a cup to serve a beverage, while other materials
- 10 such as cold water, soda water, syrup, coffee, milk and/or sugar are supplied from storage boxes via mixing means to the cup. The ice storage chamber has the capacity to serve a number of cups of the beverage (i.e. it can supply repeated sales), whereas the ice machine requires a fairly long
- 15 period to produce the quantity of ice needed to fill the storage chamber, as compared with the time taken by the vending machine to supply one cup of the beverage with ice.
- 20 A conventional beverage vendor of this type has simply a limit switch for its ice storage chamber, so that when the ice supplies are finished, sales are stopped and the ice machine starts to operate, which continues until the stor-

1 age chamber is again filled with ice. In such a vendor,
however, if successive sales are repeatedly made within a
short period, it often happens that a purchaser must wait
a fairly long time, since sales are suspended as soon as the
5 ice machine starts up, until the ice-making process ends.
That is a great inconvenience to the purchaser.

The invention as claimed is intended to remedy these draw-
backs. It solves the problem of how to design a device
10 wherein the vending service can be restarted when an ice
quantity sufficient to serve at least one cup of beverage
has been produced.

This problem is solved by an automatic vending machine
15 with the features of claim 1.

One embodiment of this invention comprises specifically:

means to produce stepwise ice-production signals the
20 number of which increases in proportion to the quantity of ice
which the ice machine feeds to the storage chamber;

means to produce stepwise ice-release signals the number
of which increases in proportion to the discharge of ice
25 from the storage chamber;

an up-down counter, which is connected so as to receive the
stepwise ice-production signals at the count-up input ter-
minal and to receive the stepwise ice-release signals at
30 the count-down input terminal, and whose content is in-
creased by one each time in response to each ice-product-
ion signal which reaches its count-up input terminal, and
is decreased by one each time an ice-release signal is giv-
en and reaches its count-down input terminal, and which
35 produces an output of on-state as long as it has a minimum

1 value of not less than a predetermined lower limit or
minimum value (e.g. one); and control means to make the vending service
available as long as the counter has its output in the
on-state.

5

The stepwise ice-production signals may be pulse signals
each of which is produced whenever the ice machine feeds
product ice in a predetermined unit quantity (e.g. the
quantity needed to serve a cup of beverage) to the ice

10 storage chamber. This can be accomplished by detecting each
lapse of time of the ice machine's operation by a predeter-
mined unit length, which results in the production of that
predetermined unit quantity of ice.

15 The stepwise ice-release signals may be produced in con-
junction with the operation of an outlet gate of the ice
storage chamber. Or specifically they may be derived from
sale signals. (The sale signal is one produced in response
to a customer's action, and intended for vending machine

20 operation. It is directly or indirectly supplied to the
ice storage chamber outlet gate actuator for the delivery
of ice to serve the beverage). In one embodiment of the
invention, each of the stepwise ice-release signals may
be produced directly in response to each sale signal, or

25 in response to each opening of the ice storage chamber's
outlet gate. In another embodiment, each stepwise ice re-
lease signal is produced whenever the ice storage chamber
outlet delivers ice in a quantity of unit storage which is
identical with that predetermined unit quantity of product

30 ice; an assembly of plural
fractions, each representing that unit storage quantity of
ice constitutes the ice quantity for a cup of the
beverage. (See descriptions below of specific embodiments).

35 Usually in modern automatic vending machines, a one-chip

1 microcomputer is used for operational control, while a
random access memory is provided in part of the micro-
computer. There a region of the random access memory can
serve as the counter used to register the ice storage quan-
5 tity. Therein the control and operation take place as fol-
lows:

1) Assume an initial situation in which the ice machine is
operating to supply ice to the storage chamber, which is
10 provided with an ice level sensor. When the ice quantity
reaches a predetermined upper level, the sensor is actuated
to produce a signal. A presetting means associated with the
counter is responsive to this signal, so as to set the
counter to a predetermined full count. In this situation
15 (because the counter has a content not less than the pre-
determined minimum value, e.g. one, in one embodiment), the
counter continues to produce an output of on-state, as a
result of which the control means makes the vending machine
ready for service.

20

2) After the sale of a cup (or cups) of iced beverage, a
certain decrease in the ice storage switches off the sensor
whereupon the ice machine starts up. The counter operates
in accordance with changes in the ice storage amounts; this
25 means that:

a) When sale of a cup of beverage is made with ice, the
counter counts a certain number n_1 downward. (In a first em-
bodiment of the invention, where the stepwise ice-release
30 signal is the sale signal itself, the n_1 number is one, i.e.
the counter counts " -1". Another case will be explained
below, with respect to a second embodiment.

b) With each pulse of the stepwise ice-production signals,
35 resulting from the ice machine's operations, the counter

1 counts "+ 1". (In the first embodiment, a count of one
in the up-down counter corresponds to the ice storage
quantity needed to serve one cup of beverage; while in a
second embodiment, it corresponds to one of the fractions
5 of that quantity).

3) If successive sales occur, serving a number of cups
of beverage with ice in a relatively short period of time
(so that the ice storage decreases far more rapidly than
10 ice is produced by the ice machine), the counter decreases
its content consecutively. When at last its content falls
to below the predetermined lower limit value, the counter
switches the output off. In response to the cessation of
output, the control means operate to stop the vending serv-
15 ice. Then a display panel shows customers a sold-out indic-
ation.

4) After such cessation of sales, when a first pulse (or
first pulses) of the ice production signal is (are) generat-
20 ed to restore the registration content to not less than
that minimum value, it (they) cause(s) the counter output
to be switched on, so that the vending service is released
from suspension, and the sold-out indicator is no longer
displayed.

25

In a modified embodiment of the invention, the above step-
wise ice-release signal production means can be formed to
generate pulse trains, each of which consists of pulse
signals, the number of which is proportional to the durat-
30 ion of the opening of the outlet gate of the ice storage
chamber, and which serve as the stepwise ice-release
signals. Such means may be an AND-gate and an oscillator,
specifically mentioned later. It is also preferable to
supply the up-down counter with a dynamic information flow
35 of variable ice quantities per cup. This is suitable for a

1 kind of automatic vending machine recently in demand,
which serves several types of beverages, or different sizes
of cups, for instance.

5 The invention is described in detail below with reference
to drawings which only illustrate specific embodiments, in
which:

Fig. 1 is a schematic block diagram of a first embodiment
10 of the vending service control device with ice-storage
counting according to the invention,

Fig. 1a is a typical up-down counter per se, to be used in
the invention,

15 Fig. 1b is a modification to the output circuit of the up-
down counter of Fig. 1a,

Fig. 2 is a typical operation chart showing signals and per-
20 formance of the device in the first embodiment,

Fig. 3 is a block diagram similar to that of Fig. 1, of a
second embodiment of the invention,

25 Fig. 4 is a typical operation chart thereof,

Fig. 4a is an expanded diagram in part (A) of Fig. 4,

Fig. 5 is a block diagram showing an electronic control
30 device including the device of the invention, using a one-
chip microcomputer,

Fig. 5a is an enlargement in part of 107 of Fig. 5,

35 Fig. 6 is an embodiment of mechanical means to set the

1 levels for switching the ice storage sensor output on and off by hysteresis,

Fig. 6a is the same as Fig. 6, but shows it in a position 5 different therefrom, and

Fig. 6b is an alternative in part thereof.

Fig. 1 is a schematic block diagram showing a first embodiment of a vending service control device with ice-storage counting for the automatic vending machine according to the invention. Miscellaneous parts which are not essential have been omitted. Reference numeral 1 denotes an ice storage sensor mounted in an ice storage chamber CH, which produces 15 a continuous output signal S_1 in so far as a predetermined full quantity of ice exists in the chamber and stops the signal when the ice stored reaches less than a predetermined short storage level. (The difference between the full quantity level and the short storage level may be almost 20 zero, as in the case of conventional devices, or it may be of an adequate value, as mentioned below.) Reference numeral 2 denotes an actuator for the ice outlet gate OG mounted in the ice storage chamber. When a vend signal S_v responds to a customer's action to require ice supply, a switch X_2 25 is closed, so as to energize actuator 2 in order that the gate OG is opened. The actuator 2 may be an electromagnetic solenoid. Reference numeral 3 denotes a motor of a compressor of an ice machine FR. Whenever the ice storage sensor 1 detects that the ice stored is quantitatively less than 30 the predetermined short storage level, i.e. whenever the sensor output signal S_1 disappears, a switch S_3 is closed, starting the motor 3. When the sensor 1 detects that the ice storage quantity is at the predetermined upper level showing full ice storage, sensor 1 produces the signal S_1 35 to open switch X_3 , stopping the motor 3 of the ice machine.

1 Up to this point the operation is substantially similar
to the other known techniques. But the device of the inven-
tion is featured by a counter 8, which is one type of the
above-mentioned up-down counter well-known per se, and for
5 which a portion of a random access memory, as normally in-
stalled in an automatic vending machine, can be used as
mentioned above.

Fig. 1a shows a typical up-down counter which may be used
10 as counter 8. The up-down counter of Fig. 1a includes flip-
flops $FF_0, FF_1, \dots, FF_i$ and gate circuits $CG_1, CG_2 \dots CG_i$
each of which is connected between two successive ones of
the cascade-connected flipflops. 801 is a count-up input,
802 is a count-down input. 803 to 806 and 821 are diodes,
15 841 to 842 are resistors. The J and K terminals of the flip
flops are all connected to a supply voltage terminal V_{DD}
(not shown). The diodes may be connected in respective
reverse directions. 861 is the output terminal of the coun-
ter.

20

Counter 8 is provided with a presetting circuit 81 (Fig. 1)
responsive to an input signal to preset counter 8 to the
predetermined content of a full count corresponding to the
number of cups of beverage served with ice which the total
25 ice storage allows. Such a presetting circuit can be formed
by plural switch elements which are respectively associated
with flip-flops of the up-down counter. The content of the
full count to which the counter is preset can be adjusted
in advance. The input signal to the presetting circuit 81
30 is fed from an auxiliary DC voltage supply V_{DD} when a
switch X_1 is closed. The switch X_1 is closed in response
to the leading edge of the sensor output signal S_1 , indic-
ating full ice storage. When the full count content is re-
corded (or more precisely, a content not less than the pre-
35 determined minimum value), the counter 8 produces an output

1 S_8 . A NOT circuit 9, which may be a transistor, is connect-
ed to the counter 8, and is responsive to the output to
deenergize a sell-out relay 10 so as to open a contact X_{11}
which is associated with the relay 10. Opening the contact
5 X_{11} , a sold-out signal lamp 11 is switched off, to indicate
that the vending machine is ready for service. Moreover
when the sell-out relay 10 is deactuated, another contact
 X_{10} is closed, supplying power to the vending mechanism.

10 Reference numerals 41 and 42 denote first and second AC/DC
signal converters, each transforming an AC input signal
of a certain duration into a DC output signal. Specifically
the second converter 42 is to produce a sustained DC output
signal identical in duration to the AC input signal. Each
15 of the signal converters 41 and 42 can be, as is known per
se, composed of a current transformer, a rectifier, conden-
sers and resistors, or can be composed of a relay and con-
tact connected with an auxiliary DC voltage supply.

20 The first signal converter 41 is connected to detect the
energization of (or the terminal voltage of) the solenoid
of ice outlet gate actuator 2. Whenever a sale signal S_v
appears which requires ice supply, closing the switch X_2 for
the ice outlet gate actuator 2, an input is supplied to
25 the converter 41, which in response thereto produces an
outlet pulse. The output of the converter 41 is supplied
to a count-down input terminal 802 of the up-down counter 8
which in response thereto counts minus one ("-1"), i.e. it
decreases the content by one. Thus in this embodiment the
30 ice storage is decreased by the quantity needed for a cup
of beverage served.

The other signal converter 42 is connected to detect power
supply to the ice machine motor 3 (for example, a current
35 transformer may be inserted in the power supply line to the

1 motor, or a voltage relay may be connected across the motor
terminals). When motor 3 is running, a continuous input is
supplied to the converter 42, and it produces its contin-
uous output signal which is supplied to a repetitive pulse
5 generating circuit 5. This circuit 5 is also connected with
a timing means 6, and produces output pulses at predeter-
mined regular intervals after the start of the continuous
output signal of the converter 42, as long as that contin-
ues (i.e. as long as motor 3 is in operation). The timing
10 means 6 serves to set the length of the regular time inter-
val. Each output pulse of the repetitive pulse generating
circuit 5 is supplied to a count-up input terminal 801 of
the up-down counter 8, which in response thereto counts
plus one (" +1"), i.e. it increases the content by one.
15 Thus in this embodiment the ice storage is increased by
the quantity needed for a cup of beverage served. By ad-
justing the setting of the length of said regular time in-
terval provided by timing means 6, it is possible to adjust
the quantity of ice which is represented by each of the re-
20 petitive pulses from the circuit 5. Specifically the cir-
cuit 5 can be formed as a duration comparison means with a
trigger, so that it compares the momentarily increasing
time lapse of an on-state of its input signal from the con-
verter 42 with the reference time interval set by the tim-
25 ing means 6, to produce an output pulse whenever that time
lapse becomes equal to an integer multiple of that refer-
ence time interval.

The content of the counter 8 moves up and down according to
30 respective input signals to the count-up and count-down
input terminals as above. If the content falls lower than
the minimum value (in this case, one) due to a number of
successive instances of downward counting for example, the
counter ceases to produce its output, so that the NOT-cir-
35 cuit (i.e. transistor) 9 energizes the sellout relay 10. Then

1 the associated contact X_{11} is closed, lighting up the sold-out signal lamp 11, while the other contact X_{10} is opened, to veto the vending service. (As an alternative, it is of course possible to use the signal lamp 11 solely for a no-
5 ice indication, and to omit the other contact X_{10} , provided that non-iced beverages can be served). This operation will be described below, in conjunction with Fig.2.

On the other hand, if few sales are made while the ice machine produces sufficient ice for full storage, the resulting
10 output signal S_1 of the ice storage sensor 1 causes the setting of the counter to the predetermined content of full count as mentioned above.

15 As to the capacity of the up-down counter 8 in the above embodiment, if it is of x bits in binary code, it suffices for the ice machine to have ice storage for y cups of beverages (i.e. y times one vending service) where $y \leq 2^x - 1$ (here "-1" means the count of zero below the above mentioned
20 minimum value).

As to the setting of levels for the ice storage quantity at which the ice storage sensor is switched on and off, they should preferably not be identical with each other,
25 but show an adequate difference (a kind of hysteresis) between them, in order to prevent too frequent stopping and starting of the ice machine, so as to increase its durability. Such a hysteresis setting may be obtained by mechanical or electrical means (the mechanical means will be described later with reference to Fig. 6-6b). Otherwise, the
30 up-down counter 8 can provide means to produce auxiliary output initiating the start-up of the ice machine, when the content of the counter falls below a predetermined intermediate value from its full count situation. In an up-
35 down counter formed by cascaded flip-flops provided with

1 diodes (821 in Fig. 1a) connected respectively to the flip-flops and to produce the counter output, the above means can be composed of additional diodes 831 (Fig. 1b) connected with one of the flip-flops which is located in a position corresponding to that intermediate value, at one end, and to a second output terminal 871 at the other end, with an additional NOT-circuit 19 (a transistor for instance), and an additional relay 20. In so far as the counter content is not less than the intermediate value, the output through the additional diodes 831 is in on-state so that the transistor 19 is conductive and prevents operation of the relay 20. When the content falls below the intermediate value, the output through the additional diode 831 becomes off-state, so that the transistor 19 is rendered non-conductive and the relay 20 is energized to initiate the ice machine's operation. (For stopping the operation of the ice machine, the sensor output signal is used as mentioned above).

20 Fig. 2 is a chart showing some typical sequential signals and operations in the device of the first embodiment, responsive to ice discharges and variations in the ice storage. It operates as follows:

25 Let us assume that the ice storage Q_{CH} reaches its full level at a time t_{11} . Then the ice-sensor signal S_1 moves to on-state (and the motor operation W_{RF} is stopped). At a time t_{12} if an ice discharge from the storage chamber takes effect, an actuator operational signal S_2 is given, so that the first signal converter 41 produces a DC pulse signal S_{41} in response to which the counter content REG decreases by one. Similar events take place for example at times t_{13} and t_{14} . Assume now that the ice storage quantity falls to the predetermined short storage level at the time t_{14} (or the content REG falls to less than the intermediate value,

35

1 not shown, at t_{14}).

Then the ice machine starts to operate (because the sensor output is switched off or because of the auxiliary output
5 of the up-down counter, as mentioned); the situation of the ice machine with motor running is represented by W_{RF} in Fig 2. When the ice machine starts, an ice motor operation signal S_3 is sent and is sustained during the running period, so that the second signal converter 42 produces a sustain-
10 ed DC signal S_{42} for the same period. At a time t_{15} when a predetermined time interval p_0 has elapsed after the time t_{14} , a pulse of signal S_5 is produced by the repetitive pulse generating circuit 5 in receipt of the sustained DC signal S_{42} . In response to the signal S_5 the counter
15 content REG increases by one. After that, successive pulses of signal S_5 are produced at the same intervals p_0 , in so far as signal S_{42} is sustained, during which when an ice discharge occurs for example at a time t_{16} , it produces similar responses to those at the time t_{12} . Thus the
20 counter content goes up and down, while the actual ice storage variation proceeds; and when the ice quantity Q_{CH} reaches the full storage level, the ice storage sensor detects it and switches its signal S_1 on at a time t_{22} , so that the ice machine is stopped, and at the same time the
25 signals S_3 and S_{42} are switched off. But on the other hand, if the downward countings exceed the upward countings in the counter, and at last the content comes to zero for example, at a time t_{32} , then the counter output S_8 is switched off and the sold-out signal (or no-ice signal) S_{10} is
30 transmitted. At an interval not longer than p_0 after the time t_{32} , a first pulse of signal S_5 of the repetitive pulse generating circuit 5 is produced, consequently the counter content increase of one switches on its output S_8 and the sold-out signal S_{10} stops. The further operations
35 are similar.

1 Fig.3 shows a second embodiment of the device of the invention. It includes parts similar to those used in Fig.1, and they are denoted by the same reference numerals. But the second embodiment is featured by an additional pulse
5 generator 12 with an AND-gate 13 connected before the count-down input terminal 802 of the up-down counter 8.

An AC/DC signal converter 41a connected before the AND-gate 13 to detect the energization or the terminal voltage
10 of the outlet gate actuator 2 is also a means to produce a sustained DC output signal identical in duration to the AC input signal, similarly to the other signal converter 42.

15 The second embodiment of the invention is aimed at optimal application to vending machine service using a variable quantity of ice supply per cup of the beverage. Here an ice quantity for a cup of service is perceived as a mass consisting of a plurality of unit assemblies, each of which is
20 a fractional unit quantity of ice. Thus a variable ice quantity for one cup served can be represented by the number of the unit assemblies (or of the fractional unit quantities) comprised therein. Therefore if pulse signals to the count-up and count-down input terminals 801,802 of the up-
25 down counter 8 are produced (as described later in detail) whenever the fractional unit quantity of ice is produced to be added to the storage chamber or discharged for service from the storage chamber, the content of counter 8 represents the ice quantity in the storage chamber more
30 accurately than in the first embodiment. In the second embodiment, the inventors show a concept in which an ice quantity supplied from the storage chamber is proportional to the time during which the ice outlet gate of the storage chamber is opened. Then those pulse signals to the
35 counter inputs are obtained in relation to the duration of

1 the operations of the ice outlet gate as well as of the
ice machine. In other words, here the counter 8 serves to
store a representation of the ice storage quantity trans-
lated into an allowable residual duration of the ice supply
5 operation. This means that the up-down counter 8 registers
digitally the length of time of ice supply operation which
the remaining ice quantity in the storage chamber can pro-
vide. It may be noted that a presetting circuit 81a, which
is substantially similar to the circuit 81 in the first em-
10 bodiment of Fig. 1, is in response to its input signal in-
tended to set the counter 8 to a predetermined content of
full count which corresponds to the duration taken by the
emptying of full ice storage when the ice outlet gate is
continuously opened.

15 The substantial difference between the counters of the
first and second embodiments is in their capacities: the
second one requires a counter of larger capacity (i.e. more
bits in binary code) than the first one, in order to deal
20 with the fine variations in its content. For example, in
the event that the duration of 30 seconds is needed to emp-
ty the full ice storage, and the average time taken to
serve ice for a cup of beverage is 2 seconds, the full con-
tent comes to $30/2 = 15$, which corresponds to 4 bits in bi-
25 nary code, in the first embodiment; while in the second
embodiment, if the fractional quantity of units is chosen
as the quantity to be discharged through the ice outlet
gate for a time of 0.1 seconds, the full content comes to
 $30/0.1 = 300$, and this requires 9 bits in binary code.

30 When operating the second embodiment of Fig. 2, the count-
er 8, when it has a full count content (or some count not
less than a predetermined minimum value, which is for ex-
ample a count corresponding to the expected maximum quant-
35 ity of ice required per cup of beverage) produces an out-

1 put similar to that mentioned in the first embodiment,
so that the NOT-circuit 9 deenergizes the sellout relay
10, to open the contact X_{11} , switching off the sold-out
signal lamp 11 and putting the vending machine in readin-
5 ess for service.

When a sale signal S_v is received which results in ice
supply being carried out by opening the ice outlet gate
for a duration of d_1 sec., i.e. by energizing the solenoid
10 2 for the duration of d_1 sec., the converter 41a receives
an input sustained for the duration of d_1 sec., and thus
produces its output for the same duration. For that durat-
ion, the AND-gate 13 which receives the output of convert-
er 41a is in a position to pass pulses supplied from the
15 additional pulse generator 12. This pulse generator 12 is a
kind of oscillator, which produces pulses at predetermined
regular intervals of p_1 sec. Then the number of pulses
passing the AND-gate 13 for the duration d_1 is proportion-
al to the length of said duration. Such pulses reach the
20 count-down input terminal 802 of the up-down counter 8.
So in response to them, the counter 8 counts downward by
the number identical to that of the pulses, i.e. it de-
creases the content by a value proportional to the length
of the duration of d_1 , which corresponds to the ice quanti-
25 ty delivered through the outlet gate from the ice storage
chamber caused by the sale signal.

While the ice machine motor 3 operates to produce ice,
a continuous input is supplied via signal converter 42 to
30 the repetitive pulse generating circuit 5, which is con-
nected with timing means 6, as in the first embodiment of
Fig. 1. Then the circuit 5 produces output pulses at predet-
ermined regular intervals of p_2 sec. during reception of the
input, i.e. while motor 3 is running. In this context the
35 difference between the two embodiments lies in the length of

1 the pulse interval defined by the timing means 6: the
second embodiment has a pulse interval p_2 far shorter than
that p_0 in the first embodiment and which is determined in
reference to the other pulse interval p_1 at which the ad-
5 ditional pulse generator 12 produces pulses, and more spec-
ifically is determined so that $p_1/p_2 = q_2/q_1$,

where p_1 and p_2 are the respective pulse intervals in the
pulse generator 12 and in the circuit 5, and q_1 and q_2 are
10 the respective ice quantities(per second) passing through
the outlet gate of the ice storage chamber and produced by
the ice machine.

Then when the ice machine is in operation, the count-up in-
15 put terminal 801 of the counter 8 receives those output
pulses from the circuit 5, so that the counter 8 counts up-
ward by the number identical with the number of pulses.i.e.
increases the content by a value proportional to the length
of time when the ice machine is in operation and corres-
20 ponding to the ice quantity produced by it.

Thus the content of the counter 8 rises and falls in simil-
ar proportion to the variations in the ice stored in the
ice storage chamber. And if the content falls below its
25 predetermined minimum value(for example a number $n_{u.\max}$
of count which corresponds to an expected maximum quant-
ity $q_{u.\max}$ of ice required per cup of beverage, or which
is expressed by $n_{u.\max} = q_{u.\max} / (q_1 p_1) = q_{u.\max} / (q_2 p_2)$),
the sold-out signal lamp 11 is lit up and the vending ser-
vice is vetoed, similarly to the description above of the
30 first embodiment.

When adjusting the setting of the length of the time interv-
al provided by the timing means 6, in the second embodi-
35 ment the device can be arranged to fulfill a variety of.

1 relationships between the ice production quantity per second by the ice machine and the ice delivery quantity per second through the ice outlet gate.

5 The second embodiment of the invention provides the best adaptability to meet the following additional requirements:

1) In case the vendor is intended for a variety of services such as several kinds of beverages or of cup sizes, the latter often require a variety of changing quantities of ice supply per cup of beverage.

2) In some cases, it is desirable for a customer to have the option of changing the ice quantities in a beverage.

3) A vendor manufacturer uses a variety of ice machines of varying capacity for different types of vendor. In that case changing adaptability to universal ice storage content and control logic is required.

Fig. 4 is a chart showing some typical sequences of signals and operations in the device of the second embodiment, responsive to ice discharges and to variations in ice storage. It acts similarly to Fig. 2. The substantial differences are as follows:

The signal S_{41a} produced by the first signal converter 41a is featured by its duration proportional to that of the actuator signal S_2 . Now another signal S_{13} is produced (as the output of the AND-gate 13); it is a pulse train which has the same duration as that of the original signal S_2 , and which consists of pulses occurring at regular intervals of p_1 sec. Each of these pulses has the effect of decreasing the counter content by one, and here each count of one

1 in the content represents a much smaller unit of ice quantity than that presumed for each count in the first embodiment. Thus a decrease of the counter content appearing in response to one unit of output of the ice outlet gate actuator signal S_2 (i.e. in response to one action of the actuator) is not always uniform, but is changeable in proportion to the duration of each output signal S_2 . Moreover the pulse interval p_2 in the signal S_5 produced by the repetitive pulse generating circuit 5 is far smaller than that
5
10 (p_0) in the first embodiment, though the attached drawings are not necessarily to scale in this context.

As to the signal carrying data of the ice discharge quantity on each vend operation, it is a pulse generated at each sale of a cup of beverage in the first embodiment above,
15 while in the second embodiment, it is a pulse train which comprises pulses generated at regular intervals and which are sustained for a time proportional to the duration of the opening of the ice storage chamber's outlet gate. Further an alternative, intermediate between the first and the second embodiments, is possible. It can be applied in cases where some variation of ice quantity per cup of beverage is required, but the changes are not numerous. There it is possible to specify several predetermined durations (or degrees) of the ice outlet gate actuator operation corresponding to such changes. Correspondingly the same plurality of types of signals can be specified to carry information as to what quantity of ice is discharged from the ice storage chamber at each sale operation. Then if in advance
25 the combinations of the varieties of ice discharge quantities and the corresponding signals are stored in a memory region of the one-chip microcomputer, the specified variety in the number of the downward count can be made in the up-down counter. In this alternative, the drawing is not appended, as the configuration is easily found without it.
30
35

1 Fig. 5 is a block diagram of an electronic control sys-
tem in an automatic beverage vending machine, provided with
a one-chip microcomputer and other members comprised in the
invention. Necessary elements such as a read only memory, a
5 random access memory, input-output ports and a clock
pulse generator are all comprised in the one-chip entity
101. The system is also provided with an input connection
circuit 107 to feed the microcomputer with various input
information such as: data for selection of commodities,
10 price-setting for commodities, setting of quantities of
materials to be served, setting of timings for discharge or
to process materials and other miscellaneous timings, with
those from the sensors for material quantities. As to the
details of the input connection circuit 107, it is composed
15 of a number of couples of on-off contacts 121 (each shown as
a cruciform), and diodes 122, as in Fig. 5a. The on-off
contacts 121 are associated with various setting switches
which give the above types of information, and for which
dip or digital switches can be used in practice. These con-
20 tacts 121 are designed as a dynamic key scan network in a
matrix, wherein an output voltage from a decoder 106 (Fig.
5) is supplied consecutively at every row of contacts which
are connected via diodes 122 and lateral lines to the input
port terminals of the microcomputer 101. Thus the input
25 port voltages changing in response to the changes in the on
off situations of the contacts 121 give the information on
external settings to the microcomputer. The diodes 122 pre-
vent any interference between the contacts belonging to
different rows at their output side. The microcomputer 101
30 is also connected with a deposition sensor 113, which de-
tects deposited coins and their denomination, so that the
computer 101 accumulates the sum of the coins and passes it
to a display 4 via a display control 105. When one of the
selection switches associated with the input connection
35 circuit 107 is actuated after the deposit of coins adequate

1 for the sale selected, the microcomputer 101 operates to
produce the necessary electronic outputs to initiate the
sale, so that the outputs are led through an amplifier 102
to manipulate the necessary vending mechanisms 103 to feed
5 materials, to process them etc. The mechanisms 103 include
for example cup serving motors, several syrup supplies,
cold water supply, soda water supply, ice outlet gate act-
uator, ice machine motor, water cooler, various control
valve actuators, various auxiliary counters and various
10 drive elements such as change-issuing solenoids for the
coin mechanism etc. Their operations are initiated by elect-
ronic outputs directly or via certain magnetic relays.

The microcomputer 101 further includes means to produce
15 signals for the initiation of operations to stop coin de-
posits when their amount exceeds a required value, or to
return the change, as well as signals to initiate various
controls for the refrigerator and valves to maintain a
predetermined cold water temperature, its quantity and the
20 ice storage quantity.

The microcomputer 101 is also connected with various in-
dicator lamp circuits which include the no-ice signal lamp
indicating a shortfall in ice storage together with various
25 other indicator lamps showing no coin storage for change,
sellout due to under-storage of materials such as syrups,
soda water, cold water and cups, as well as lamps to ind-
icate available commodities corresponding to the amount of
coins deposited which are switched off when subsequent op-
30 erations have taken place of the various vending mechanisms
so that for example when a selection switch is actuated for
a commodity, a lamp corresponding to it remains in on-state
but others are switched off. In the case of a vending mach-
ine for twelve kinds of commodities, or beverages, provided
35 with both indicator lamps for availability and for sellout

1 of each of them, they require 24 indicator lamp units, and
in addition several lamps are required for other purposes
such as indicating that the vendor is in service, lacking
5 coins for change, etc. In consequence about 30 indicator
lamp units are required, together with electronic circuits
connected to them. The number of the circuits exceeds the
number of control output terminals with which the usual
one-chip microcomputer is equipped. Therefore the device as
shown in Fig. 5 is provided with a group of shift registers
10 SR1, SR2 etc., connected to the microcomputer 101. This
computer 101 includes means to supply clock pulses CL. The
number of kinds of control data is sent to the shift reg-
isters SR1, SR2 etc., shifting consecutively with every
generation of the clock pulse CL. Thus an effect equivalent
15 to an increase in the number of control output terminals of
the microcomputer 101 is produced. Each of the circuits
connected after the shift register comprises an amplifier
109, an AND-gate 110, an indicator lamp 111 and a vend coun-
ter 112. When a selection switch is actuated to sale of a
20 commodity or beverage, the corresponding lamp at 111 remains
in the on-state while the others are switched off as men-
tioned; after that, when a signal is produced to inform the
computer that the sale has been completed, a pulse CT is
supplied to the AND-gate 110, resulting in a count of one
25 in the associated vend counter 112, so that it registers
the number of sales of that particular commodity.

Ice supply quantity setting means, as mentioned in other em-
bodiments, as well as various other vend quantity setting
30 means, are connected with the device (although they are not
shown in Fig. 5) and they operate similarly to the means
already mentioned above.

Fig. 6 is to show an embodiment of mechanical means for
35 setting the levels to switch the ice storage sensor output

1 on and off with hysteresis as mentioned in relation to the
first embodiment. Here the means comprise a hysteresis set-
ter(i.e. a first mechanical member) 233, a lever(a second
mechanical member) 236 and a microswitch 232, which are
5 shown with an essential portion 212 of an ice machine 211
and its ice storage chamber 213. A coolant coil 215 of
the ice machine cools water fed through an inlet 216. A
screwed shaft 218 with a motor 217 scrapes out ice flakes
produced on the inside of cooling cylinder 214, and carries
10 them upward into the storage chamber 213 through a crush-
ing ring 220, which breaks the ice flakes into small pieces
221. A floating disk 229 is placed over the upper surface
of the storage of the ice pieces, moving vertically with
the variation of the ice storage quantity. A movable rod
15 230 is linked with disk 229, and on top of the rod 230 the
hysteresis setter 233 is removably mounted with a screw
bolt 234. When the ice storage quantity is decreasing and
falls to a predetermined level, an upper flange 233a of the
setter 233 thrusts the lever 236 downward, so that it
20 causes the closure of the microswitch 232, at a position
shown as in Fig. 6. A pair of magnetic members 237 is
mounted on the lever 236 and a stationary part of the mi-
croswitch 232, producing an attraction force between them,
so that contacts of the microswitch 233, once placed in the
25 contact-making position, are then kept in that position
without the continuation of the thrusting force of the
upper flange 233a of the setter 233. On the other hand,
when the ice storage quantity is increasing, rod 230 moves
upward with the setter 233. At last at another position
30 as in Fig. 6a, a lower flange 233b moves the lever 236 up,
to break contact with microswitch 232. The upper and lower
flanges 233a and 233b are vertically spaced. The hysteresis
setter 233 can be changed so the distance between the upper
and lower flanges 233a and 233b is also changeable. In an
35 alternative, the setter 233 comprises two pieces 239 and

1 240 as shown in Fig. 6b, and they have upper and lower
flanges 239a and 240a respectively; then they can provide
optimal adjustment of the distance between them.

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C L A I M S:

1 1) An automatic vendor having an ice machine (FR) with a
storage chamber (CH, 213) in which the ice produced is
stored and from which the ice is supplied whenever a sale
requires it, and which is provided with a sensor(1, X1;
5 229,230,233,232) producing a signal when the ice quantity
in the chamber reaches a predetermined full storage
level, c h a r a c t e r i z e d by:

means (42,5,6; 41,41a,12,13) producing digital signals
10 which represent quantities of ice produced for and dis-
charged from the storage chamber; a counter (8)
supplied with the signals which dynamically registers the
balance between them, and which produces an output(S₈)
when its registration is not less than a predetermined
15 minimum value; and vend control means(9,10,X₁₀) respon-
sive to the counter output to veto sales when and only when
the output is stopped.

2) The vendor as set out in claim 1, further c h a r a c t-
20 e r i z e d in that a sellout indicator (11) is responsive to
the counter output, to show the situation in which no ice
can be served.

3) The vendor as set forth in claims 1 and 2, further
25 c h a r a c t e r i z e d by:

means(42,5,6) to produce stepwise ice production signals
(S5) to a number increasing in proportion to the supply of
ice by the ice machine to the storage chamber(CH);

30 means (41; 41a,12,13) to produce stepwise ice release
signals(S41, S13) to a number increasing in proportion to the discharge
of ice from the storage chamber;

35 whereby the stepwise ice production signals serve as the

- 1 digital signals which represent quantities of ice produced, while the stepwise ice release signals serve as the other digital signals which represent quantities of ice discharged; said counter (8) being an electronic up-down
5 counter in which an addition of one to its count is made in response to a pulse signal arriving at its count-up input terminal, and a subtraction of one is made from the count in response to a pulse signal arriving at its count-down input terminal, and which produces an output (S8) in
10 so far as it has a content not less than the predetermined minimum value, and which is connected to receive the stepwise ice-production signals at the count-up input terminal (801) and to receive the stepwise ice-release signals at the count-down input terminal (802); and
15 said vend control means including a NOT-circuit (9) responsive to the absence of counter output, to produce an output which energizes a relay (10) to operate the sale veto with the sellout indication.
- 20 4) The vendor as set forth in claim 3, characterized in that:
- 25 the stepwise ice-production signals are pulse signals each of which is produced whenever the ice machine feeds ice in a predetermined unit quantity, and then a momentarily increasing quantity of ice produced is represented by a lapse of running time of the ice machine's operations; and that the stepwise ice release signals are produced
30 in conjunction with the operation of the outlet gate (OG) of said ice storage chamber (CH).
- 35 5) Vendor as set out in claim 4, characterized in that a signal representing the outlet gate operation is identified with a sale signal produced in response to an external

1 manual action intended for a sale operation.

6) The vendor as set forth in claim 4, characterized in
that each stepwise ice release signal is produced whenever
5 the ice storage chamber outlet (OG) discharges ice by
a unit storage quantity which is identical with the said
predetermined unit quantity of ice produced, and then a
momentarily increasing quantity of ice is represented after
discharge by a lapse of time during which the outlet gate
10 was maintained in the open position.

7) The vendor as set forth in claim 3, characterized in
that the up-down counter is provided with an auxiliary
output circuit(831) in addition to a primary output cir-
15 cuit(821) which serves to supply said counter output to
said NOT- circuit (9); and the auxiliary output circuit
produces an output when the counter content is
above a predetermined median value less than the full
count; and that the icemachine(FR) begins to operate
20 when an interruption of the auxiliary output appears.

8) The vendor as set forth in claim 7, characterized in
that:

the primary output circuit is an OR- circuit composed of
25 a set of parallel diodes (821), each of which is connected
to one of the cascaded flip-flops (FF_1 - FF_1) in the up-
down counter (8); said auxiliary output circuit is an
additional OR-circuit composed of another set of parallel
diodes (831) each connected with one of the flip-flops which
30 operate to represent values not less than said median
content value less than the full count; and

an auxiliary NOT- circuit (19) is connected to receive the
auxiliary output and responsive to its absence to produce
35 another output energizing another relay(20) to start the ice

1 machine.

9) The vendor as set forth in claims 1,2 or 3 characterized
in that:

5

the ice storage sensor(1) includes means for setting the
levels to switch the sensor output on and off with hysteresis; and that the means comprise:

10

a) a first mechanical member(233) moving upward and downward as the ice quantity in the storage chamber(213) varies,

15

b) upper and lower flanges (233a, 233b) mounted on the
mechanical member vertically spaced from each other,

c) a second mechanical member(236) also movable, having a
portion within the space between the upper and lower flanges with adequate idling,

20

d) an electrical switch(232) turned on and off by the motion of said second mechanical member, and

25

e) a pair of magnetic members(237) mounted on the second
mechanical member(236) and on a stationary member facing
it, and which are in contact with each other so as to produce a force to hold the second mechanical member(236) in
the position to close the electrical switch, whereby when
said second mechanical member (236) arrives at such position by a downward motion of the upper flange (233a) of
said first mechanical member(233), it remains there until
the lower flange(233b) abuts it, thereby driving it upwards.

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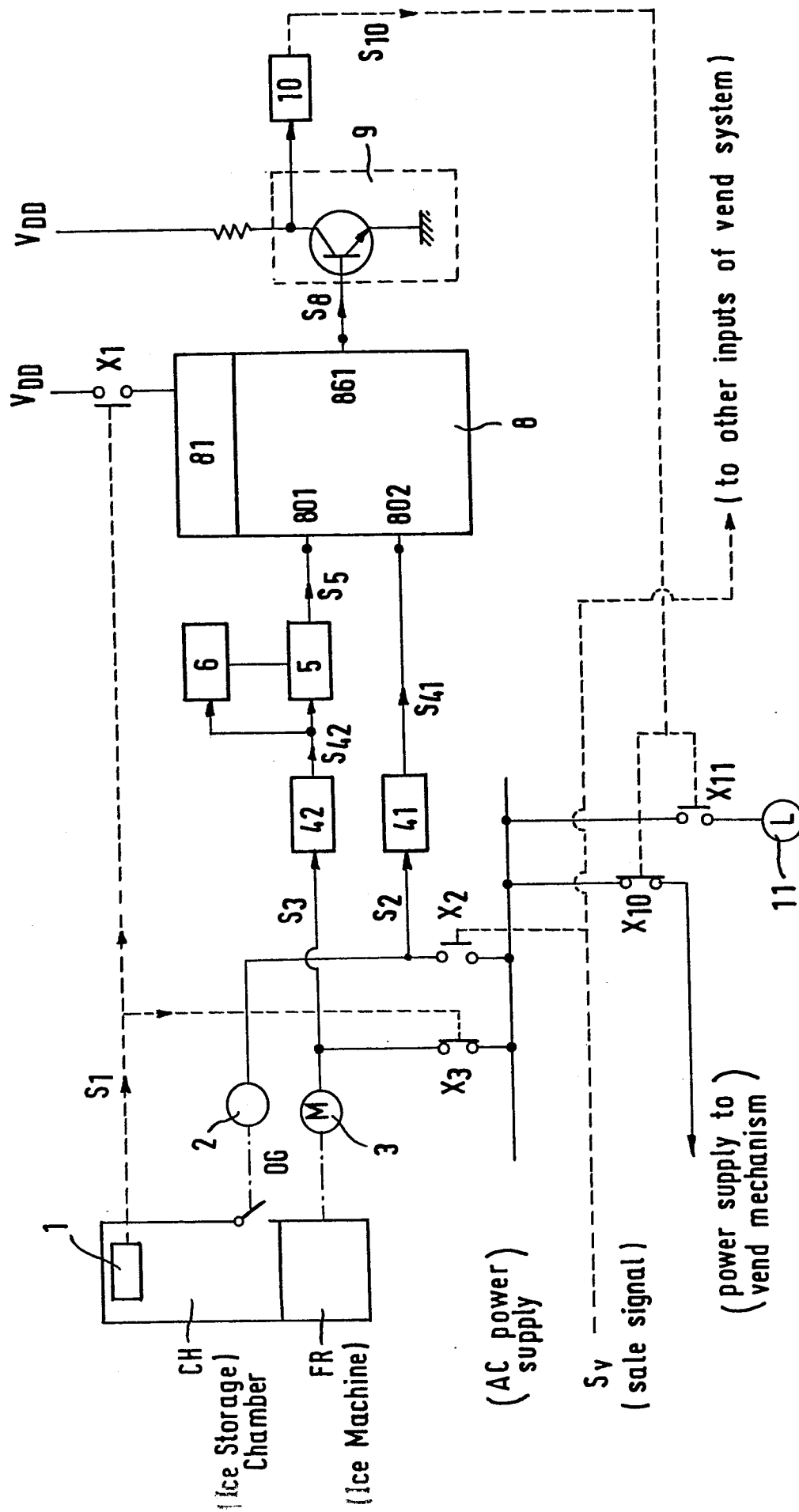


FIG. 1

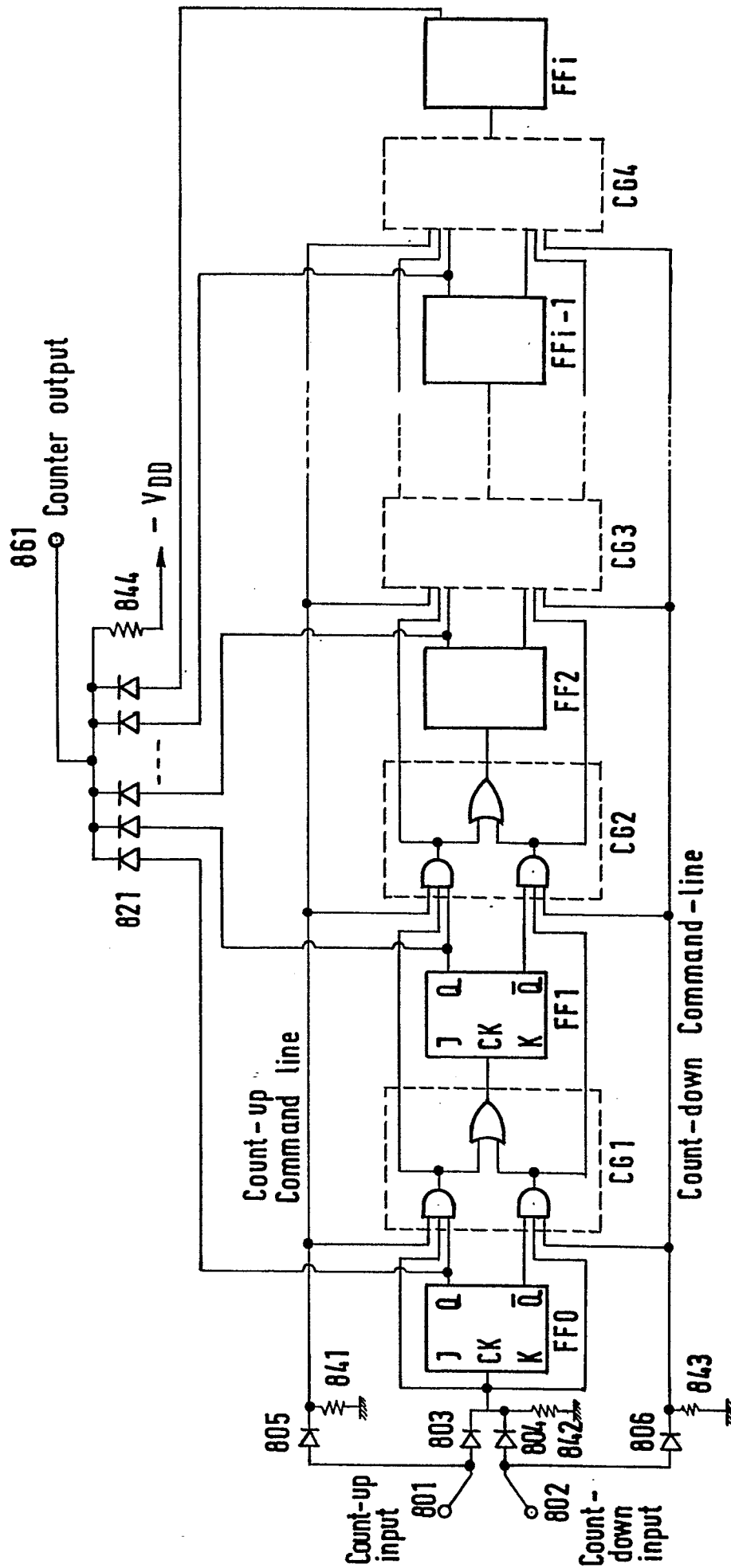


FIG. 1a

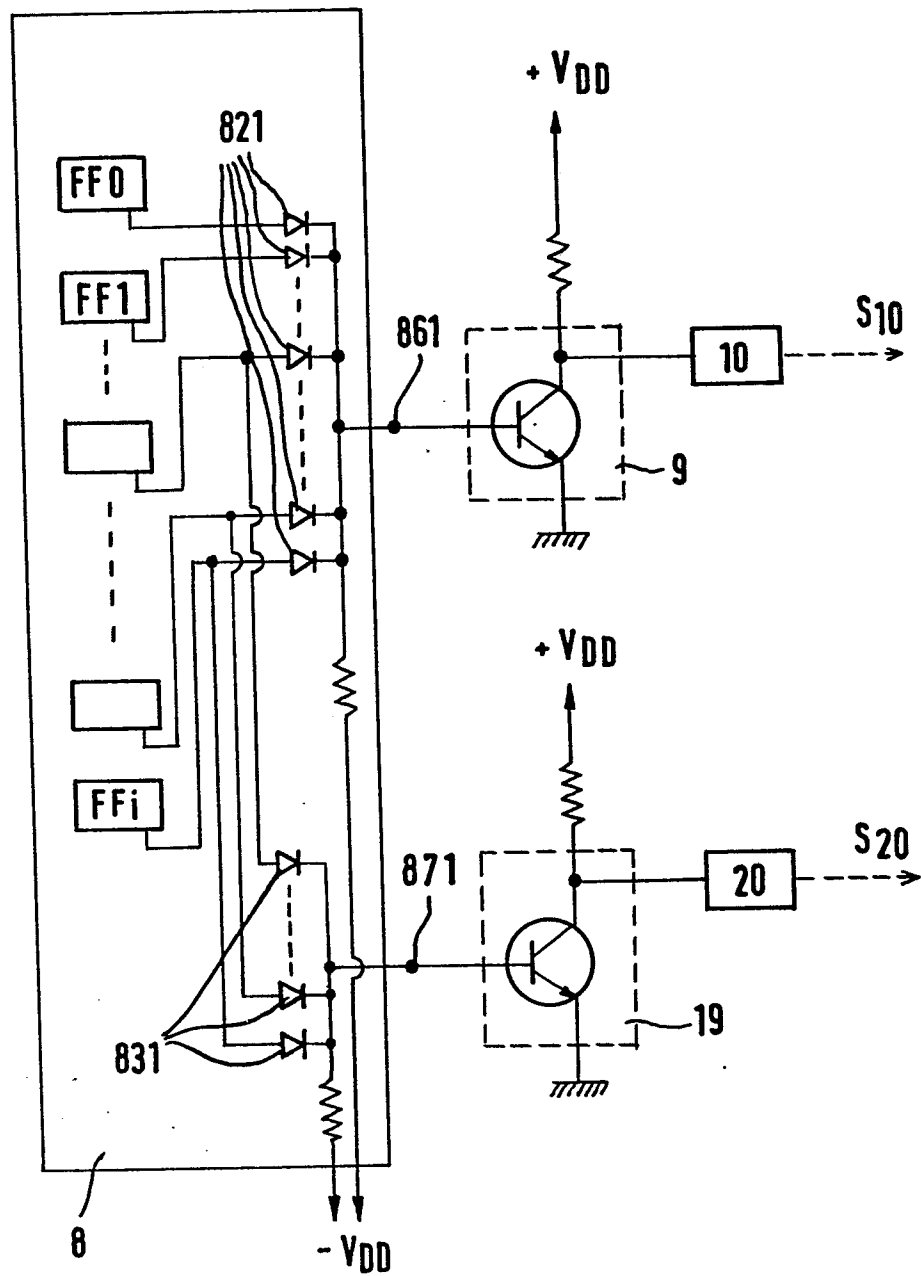


FIG. 1 b

FIG. 2

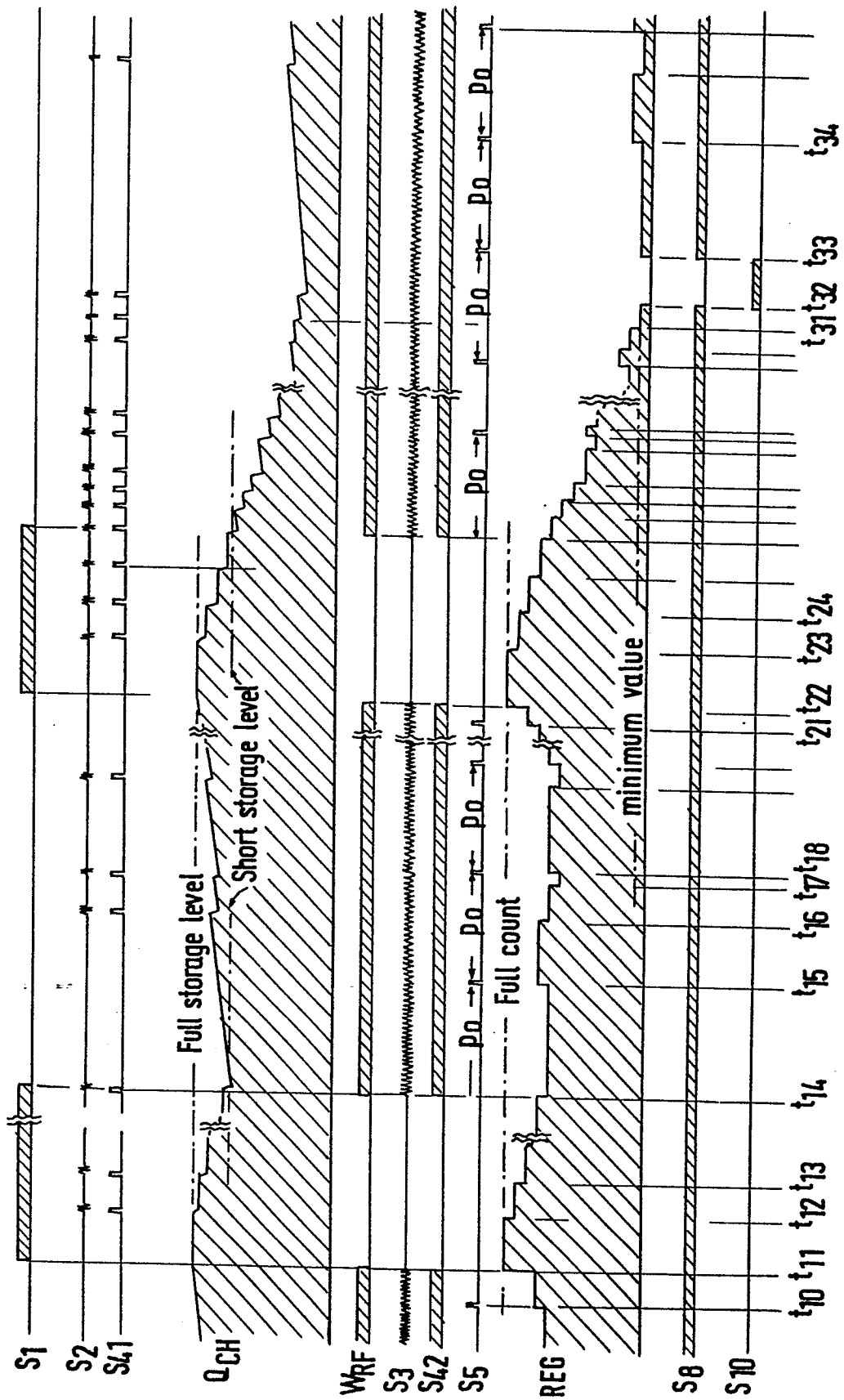




FIG. 3

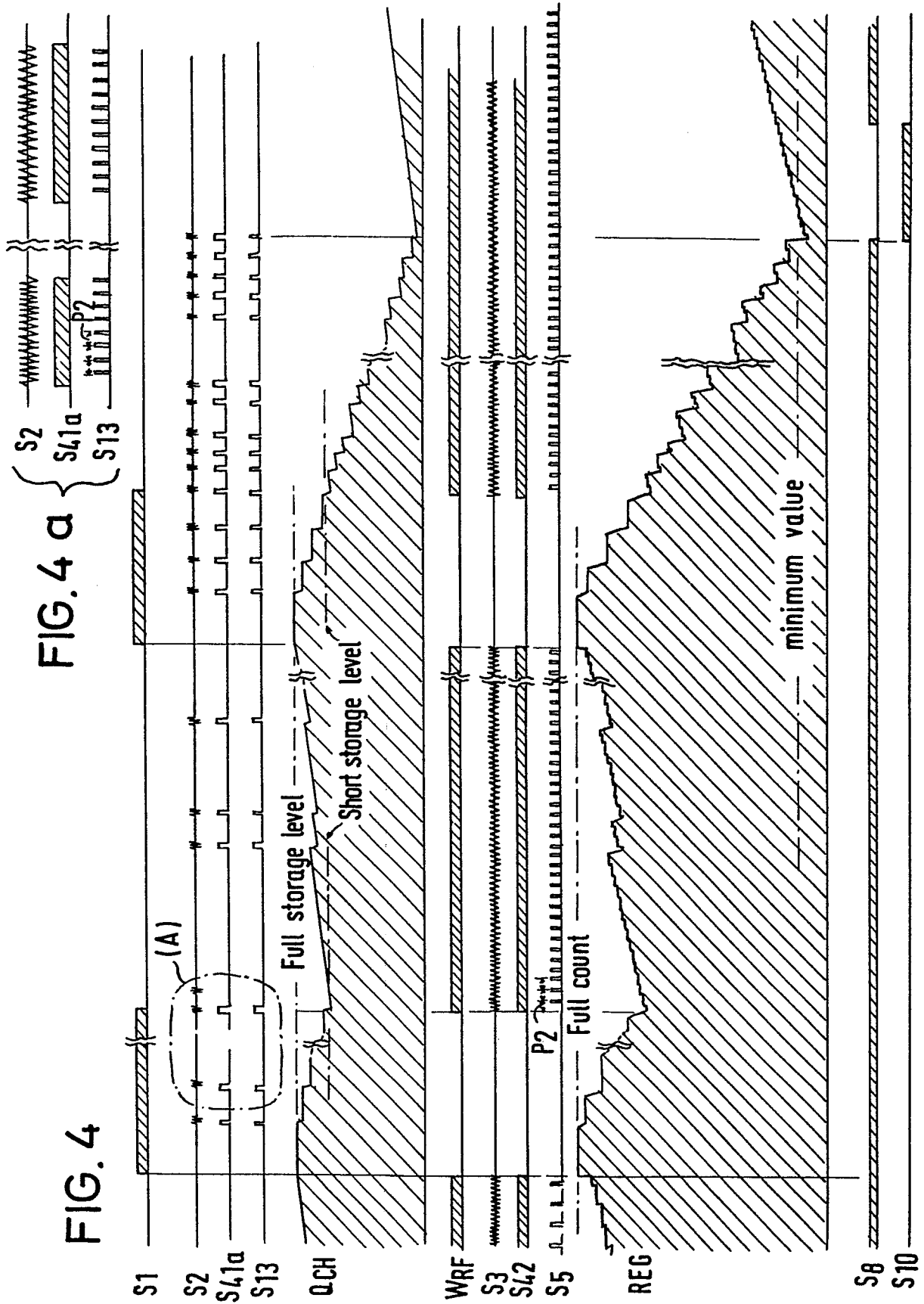


FIG. 5

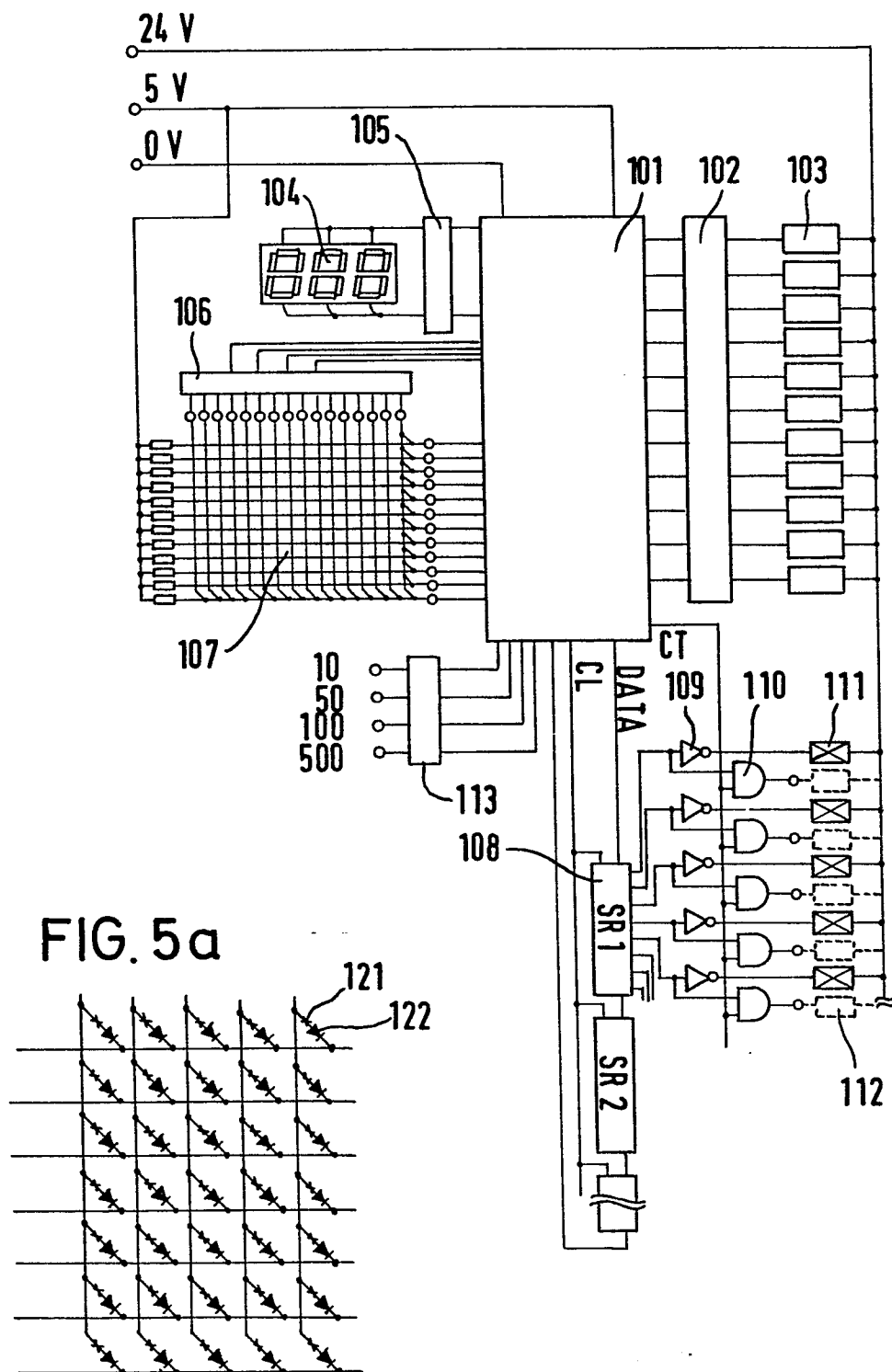


FIG. 6a

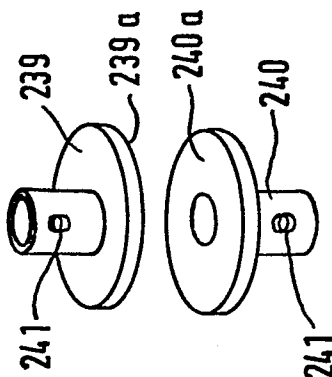
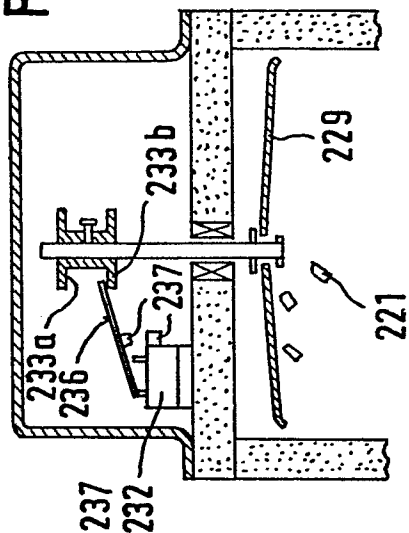
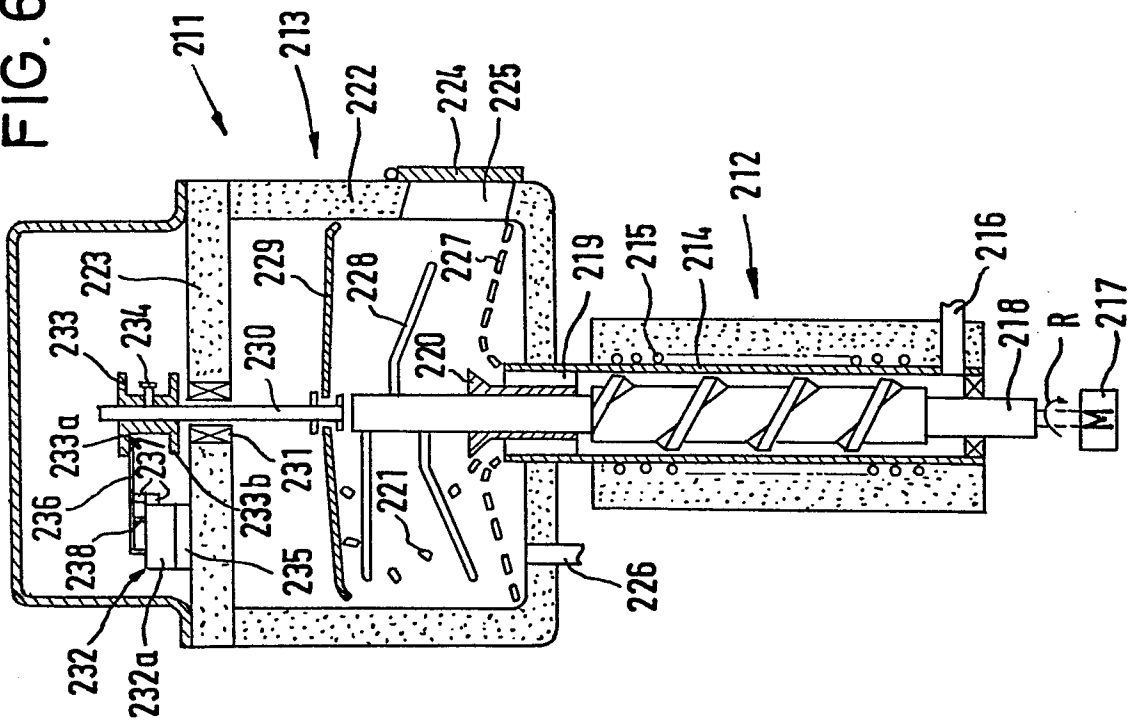


FIG. 6 b

FIG. 6





European Patent
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EUROPEAN SEARCH REPORT

0069795

Application number

EP 81 10 5513

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl. 2)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
X	PATENTS ABSTRACTS OF JAPAN, vol. 2, no. 109, E.Section, September 9, 1978, & JP - A - 53 74 500 (FUJI DENKI SEIZO K.K.)(01-07-1978) * Abstract *	1-8	G 07 F 13/00 F 25 C 5/00
	--		
A	US - A - 2 961 842 (G.K. WRIGHT) * Column 4, lines 56-71; figures 1-3,6 *	9	
	--		
A	US - A - 3 441 176 (D.S. REYNOLDS) * Column 5, lines 29-43; figure 2 *	9	
	--		
A	US - A - 3 911 691 (V.L. KOHL) * Column 3, lines 14-28; figures 3,4 *	9	

			TECHNICAL FIELDS SEARCHED (Int.Cl. 3)
			G 07 F 13/00 13/06 13/10 F 25 C 1/00 5/00 5/18 B 67 D 5/62
			CATEGORY OF CITED DOCUMENTS
			X: particularly relevant if taken alone Y: particularly relevant if combined with another document of the same category A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: earlier patent document, but published on, or after the filing date D: document cited in the application L: document cited for other reasons &: member of the same patent family, corresponding document
☒ The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 02-03-1982	Examiner RUDOLPH